FAIRCHILD SEMICONDUCTOR®

# FGH40T120SMD / FGH40T120SMD_F155

## 1200 V, 40 A FS Trench IGBT

## Features

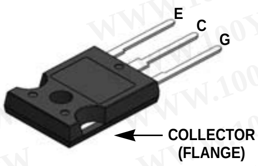
- FS Trench Technology, Positive Temperature Coefficient
- High Speed Switching
- Low Saturation Voltage: $V_{CE(sat)}$ =1.8 V @ $I_C$ = 40 A
- 100% of the Parts tested for $I_{LM}$(1)
- High Input Impedance
- RoHS Compliant

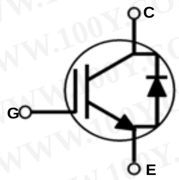
## General Description

Using innovative field stop trench IGBT technology, Fairchild®'s new series of field stop trench IGBTs offer the optimum performance for hard switching application such as solar inverter, UPS, welder and PFC applications.

## Applications

- Solar Inverter, Welder, UPS & PFC applications.




## Absolute Maximum Ratings $T_C$ = 25°C unless otherwise noted

| Symbol | Description | | Ratings | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | | 1200 | V |
| $V_{GES}$ | Gate to Emitter Voltage | | ±25 | V |
| | Transient Gate to Emitter Voltage | | ±30 | V |
| $I_C$ | Collector Current | @ $T_C$ = 25$^o$C | 80 | A |
| | Collector Current | @ $T_C$ = 100$^o$C | 40 | A |
| $I_{LM}$ (1) | Clamped Inductive Load Current | @ $T_C$ = 25$^o$C | 160 | A |
| $I_{CM}$ (2) | Pulsed Collector Current | | 160 | A |
| $I_F$ | Diode Continuous Forward Current | @ $T_C$ = 25$^o$C | 80 | A |
| | Diode Continuous Forward Current | @ $T_C$ = 100$^o$C | 40 | A |
| $I_{FM}$ | Diode Maximum Forward Current | | 240 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25$^o$C | 555 | W |
| | Maximum Power Dissipation | @ $T_C$ = 100$^o$C | 277 | W |
| $T_J$ | Operating Junction Temperature | | -55 to +175 | $^o$C |
| $T_{stg}$ | Storage Temperature Range | | -55 to +175 | $^o$C |
| $T_L$ | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | | 300 | $^o$C |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$(IGBT) | Thermal Resistance, Junction to Case | -- | 0.27 | $^o$C/W |
| $R_{\theta JC}$(Diode) | Thermal Resistance, Junction to Case | -- | 0.89 | $^o$C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | -- | 40 | $^o$C/W |

**Notes:**
1. Vcc = 600 V,$V_{GE}$ = 15 V, $I_C$ = 160 A, $R_G$ = 10 Ω, Inductive Load
2. Limited by Tjmax

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FGH40T120SMD | FGH40T120SMD | TO-247 A03 | - | - | 30 |
| FGH40T120SMD | FGH40T120SMD_F155 | TO-247G03 | - | - | 30 |

## Electrical Characteristics of the IGBT $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $V_{GE}$ = 0 V, $I_C$ = 250 uA | 1200 | - | - | V |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE} = V_{CES}$, $V_{GE}$ = 0 V | - | - | 250 | uA |
| $I_{GES}$ | G-E Leakage Current | $V_{GE} = V_{GES}$, $V_{CE}$ = 0 V | - | - | ±400 | nA |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C$ = 40 mA, $V_{CE} = V_{GE}$ | 4.9 | 6.2 | 7.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 40 A, $V_{GE}$ = 15 V<br>$T_C$ = 25°C | - | 1.8 | 2.4 | V |
| | | $I_C$ = 40 A, $V_{GE}$ = 15 V,<br>$T_C$ = 175°C | - | 2.0 | - | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V,<br>f = 1MHz | - | 4300 | - | pF |
| $C_{oes}$ | Output Capacitance | | - | 180 | - | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | - | 100 | - | pF |
| **Switching Characcteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 600 V, $I_C$ = 40 A,<br>$R_G$ = 10 Ω, $V_{GE}$ = 15 V,<br>Inductive Load, $T_C$ = 25°C | - | 40 | - | ns |
| $t_r$ | Rise Time | | - | 47 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 475 | - | ns |
| $t_f$ | Fall Time | | - | 10 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 2.7 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 1.1 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 3.8 | - | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 600 V, $I_C$ = 40 A,<br>$R_G$ = 10 Ω, $V_{GE}$ = 15 V,<br>Inductive Load, $T_C$ = 175°C | - | 40 | - | ns |
| $t_r$ | Rise Time | | - | 55 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 520 | - | ns |
| $t_f$ | Fall Time | | - | 50 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 3.4 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 2.5 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 5.9 | - | mJ |
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 600 V, $I_C$ = 40 A,<br>$V_{GE}$ = 15 V | - | 370 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | - | 23 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | - | 210 | - | nC |

## Electrical Characteristics of the DIODE $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 40 A, $T_C$ = 25$^o$C | - | 3.8 | 4.8 | V |
| | | $I_F$ = 40 A, $T_C$ = 175$^o$C | - | 2.7 | - | V |
| $t_{rr}$ | Diode Reverse Recovery Time | $V_R$ = 600 V, $I_F$ = 40 A, $di_F/dt$ = 200 A/us, $T_C$ = 25$^o$C | - | 65 | - | ns |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | | - | 7.2 | - | A |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | - | 234 | - | nC |
| $t_{rr}$ | Diode Reverse Recovery Time | $V_R$ = 600 V, $I_F$ = 40 A, $di_F/dt$ = 200 A/us, $T_C$ = 175$^o$C | - | 200 | - | ns |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | | - | 18.0 | - | A |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | - | 1800 | - | nC |

## Typical Performance Characteristics

**Figure 1. Typical Output Characteristics**

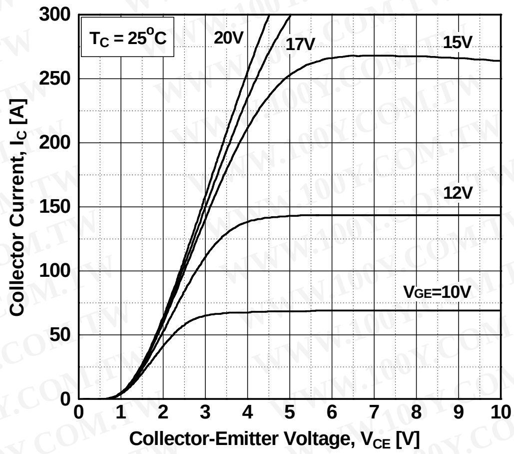



**Figure 2. Typical Output Characteristics**

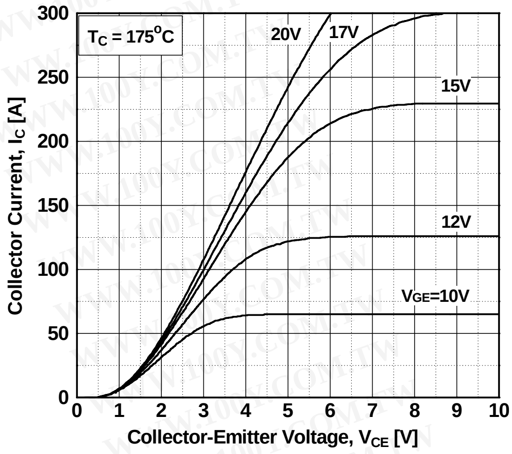



**Figure 3. Typical Saturation Voltage Characteristics**

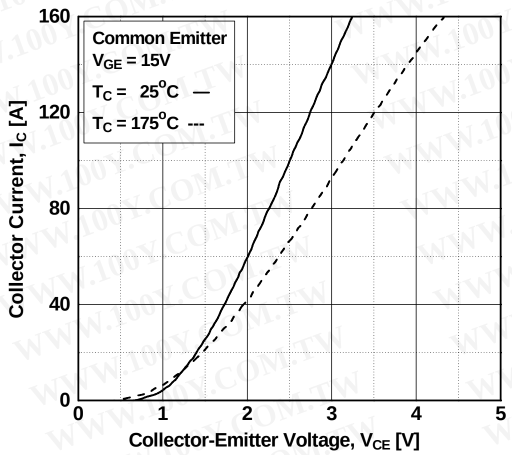



**Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level**

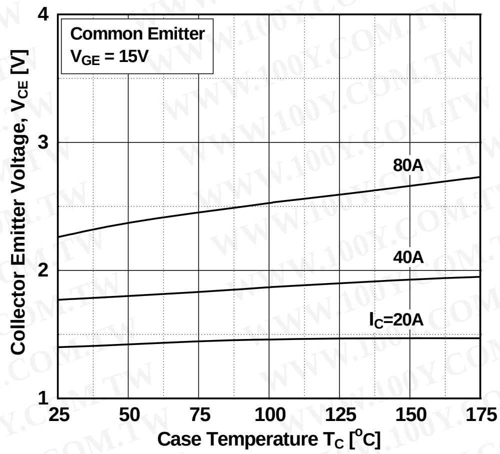



**Figure 5. Saturation Voltage vs. $V_{GE}$**

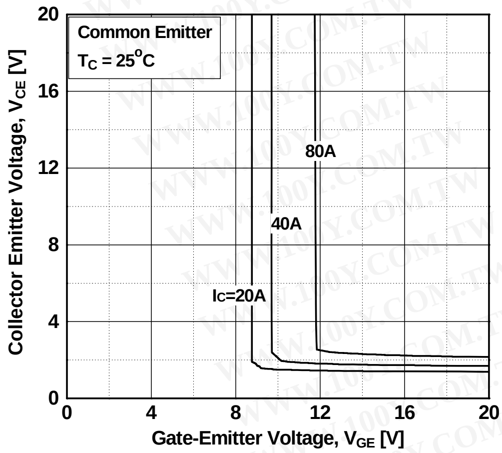
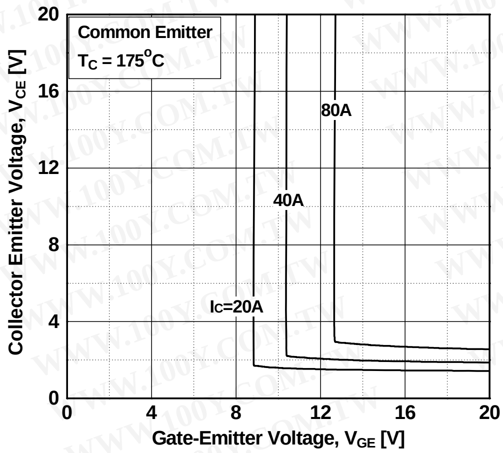



**Figure 6. Saturation Voltage vs. $V_{GE}$**



## Typical Performance Characteristics

**Figure 7. Capacitance Characteristics**

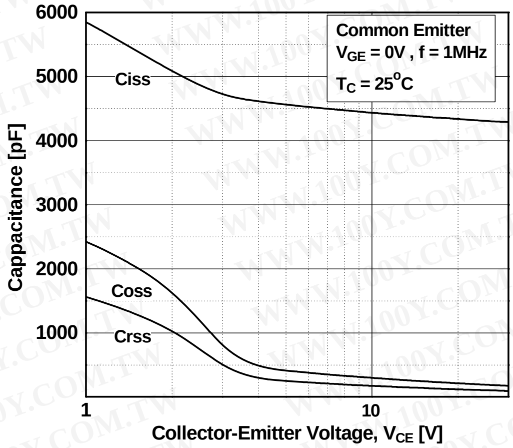



**Figure 8. Load Current vs. Frequency**

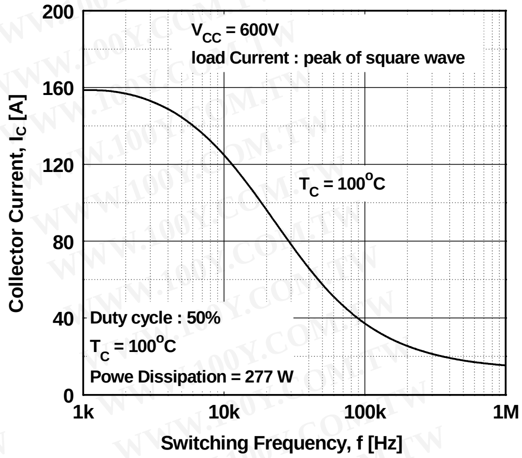



**Figure 9. Turn-on Characteristics vs. Gate Resistance**

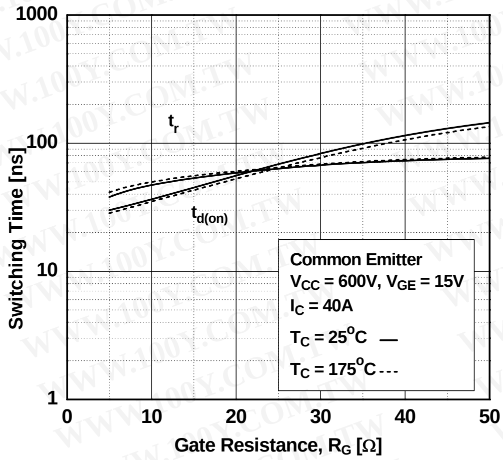



**Figure 10. Turn-off Characteristics vs. Gate Resistance**

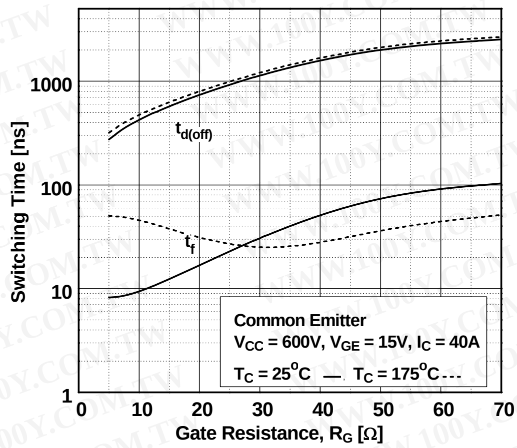



**Figure 11. Swithcing Loss vs. Gate Resistance**

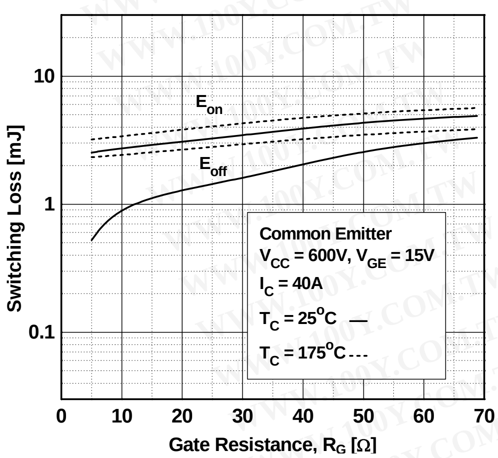
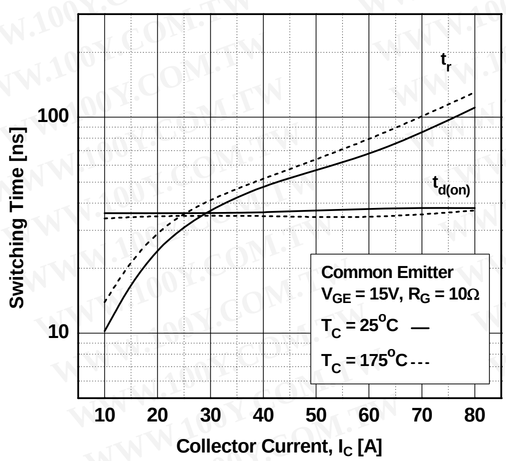



**Figure 12. Turn-on Characteristics vs. Collector Current**



## Typical Performance Characteristics

**Figure 13. Turn-off Characteristics vs. Collector Current**

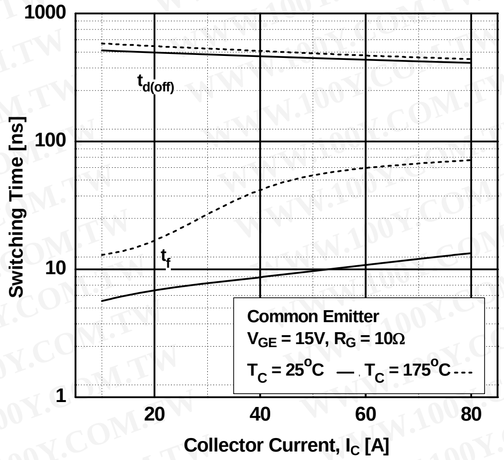



**Figure 14. Swithcing Loss vs. Collector Current**

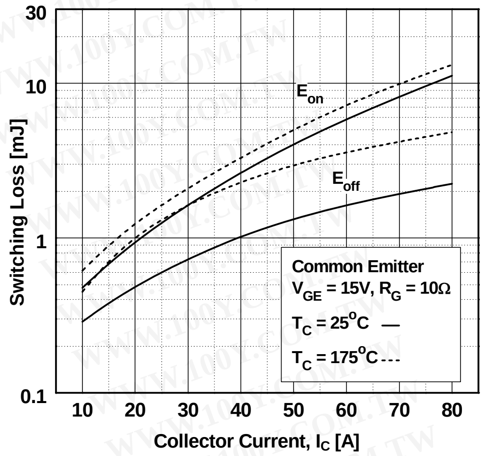



**Figure 15. Gate Charge Characteristics**

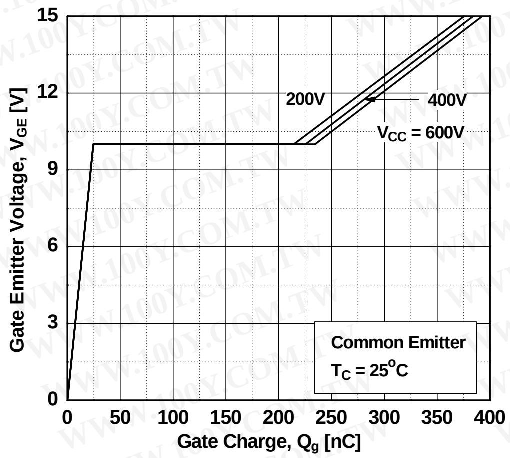



**Figure 16. SOA Characteristics**

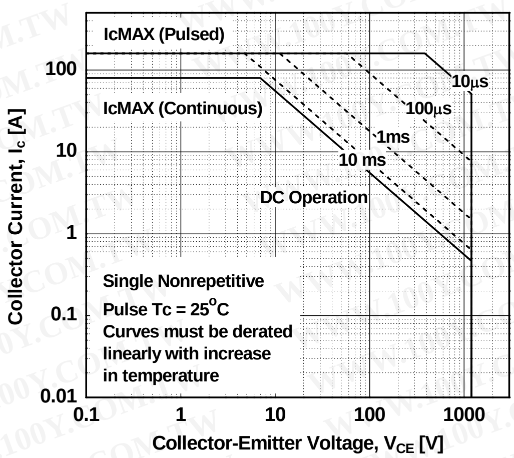



**Figure 17. Forward Characteristics**

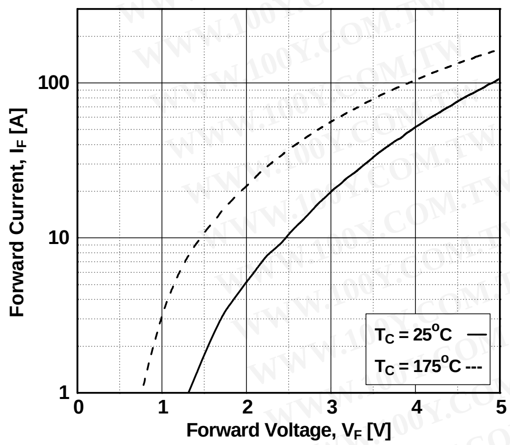
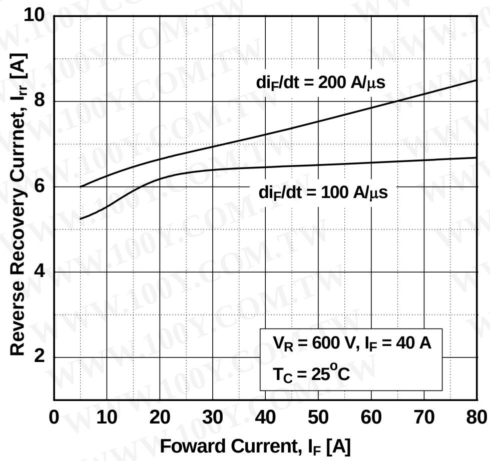



**Figure 18. Reverse Recovery Current**



## Typical Performance Characteristics

**Figure 19. Reverse Recovery Time**

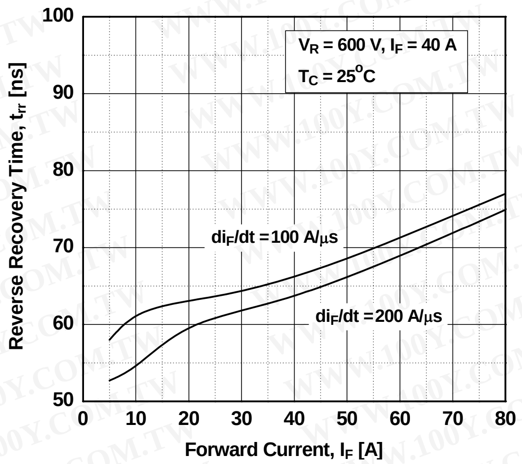



**Figure 20. Stored Charge**

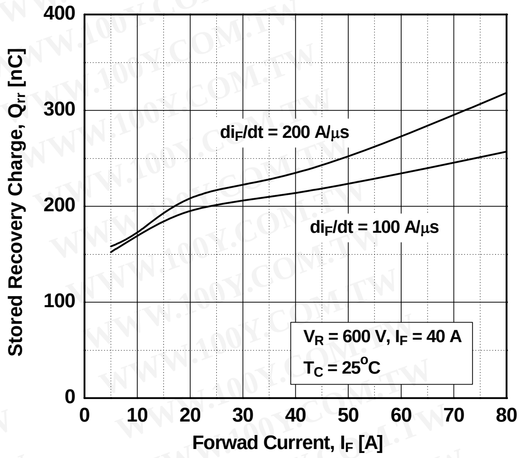
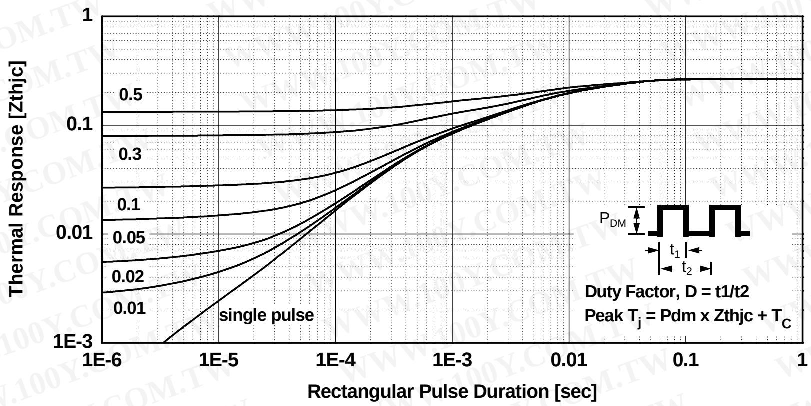
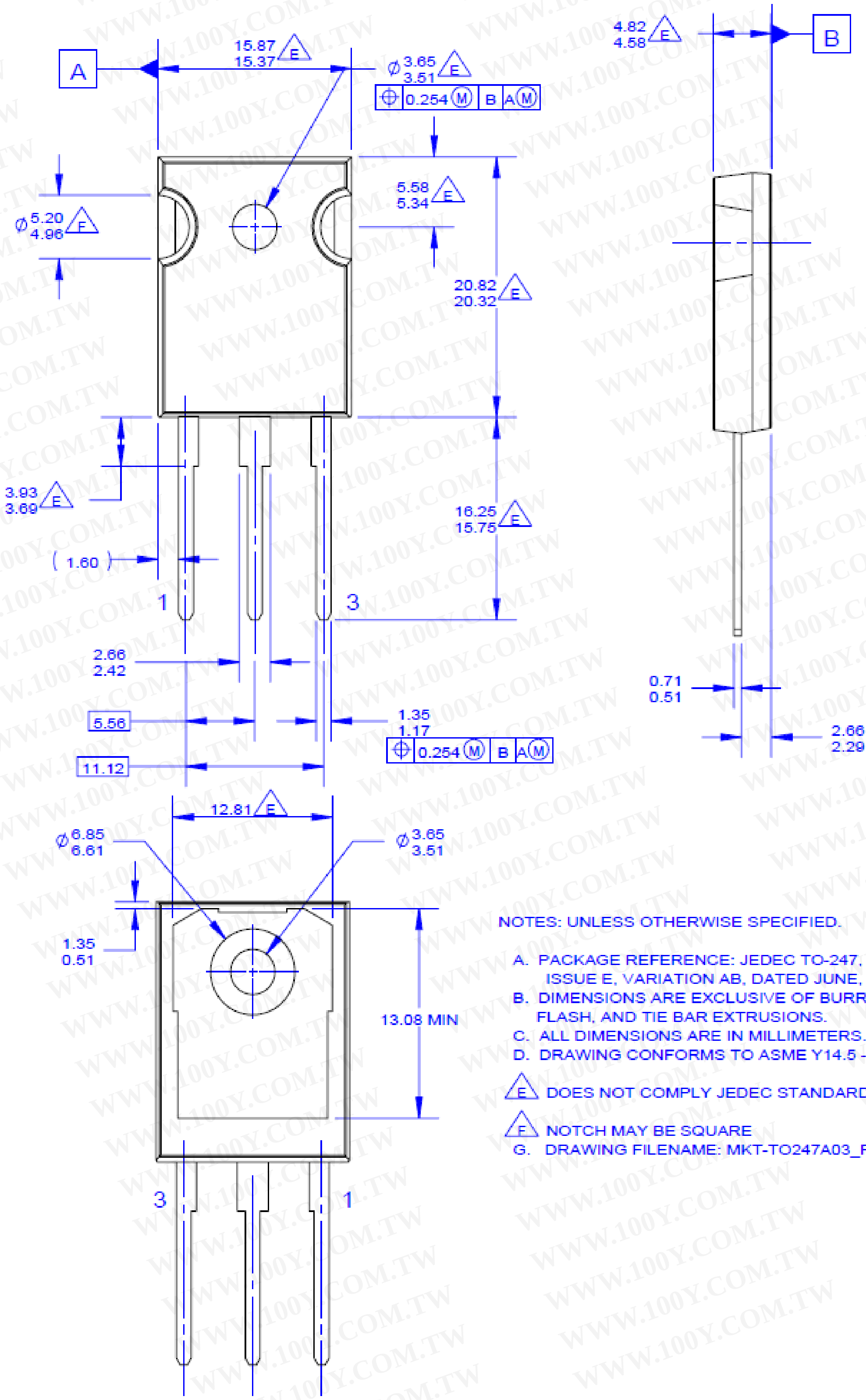



**Figure 21. Transient Thermal Impedance of IGBT**



## Mechanical Dimensions

### TO - 247A03




NOTES: UNLESS OTHERWISE SPECIFIED.

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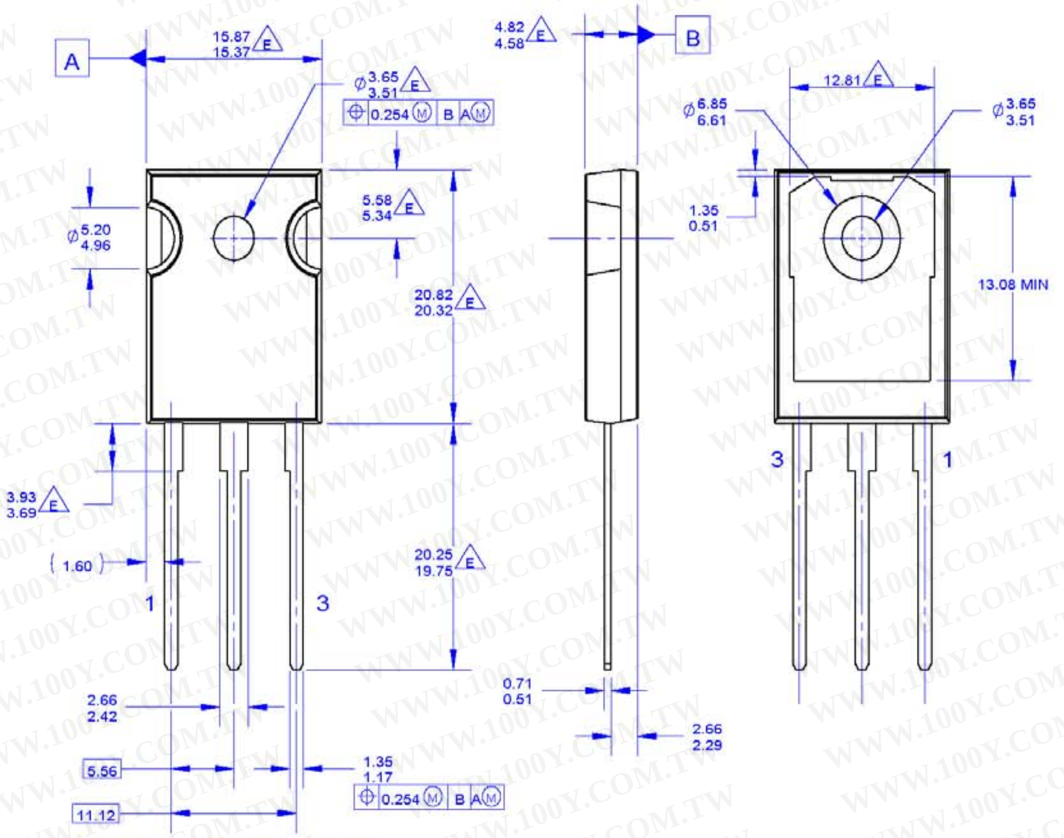
E. DOES NOT COMPLY JEDEC STANDARD VALUE
F. NOTCH MAY BE SQUARE
G. DRAWING FILENAME: MKT-TO247A03_REV03

## Mechanical Dimensions

# TO-247G03

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| Datasheet Identification | Product Status | Definition |
|---|---|---|
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| No Identification Needed | Full Production | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design. |
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